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Article

Categorising urban games from a sustainability perspective

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ABSTRACT

In recent years, games have emerged as a significant focal point in urban studies. This paper examines urban games through the lens of sustainability. The exploration of urban games from a sustainability perspective is compelling due to the historical coexistence of these two subjects, yet their interrelationship remains unexplored. By reviewing literature and online platforms for existing games, we compiled a database of 173 urban games. We categorized their principal characteristics by location, number of players, target group, benefit to the target group, three sustainability pillars, and related Sustainable Development Goals (SDGs).
In conclusion, when findings from both urban planning and sustainability perspectives are combined, it becomes evident that these games emphasize the role of individuals in society with regard to sustainability, underscoring their responsibilities. Ultimately, public participation stands out as a key focus.

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INTRODUCTION

Sustainability has gained importance since the 1990s and remains crucial for society. Due to the increasing population, emerging environmental problems in urban areas demand immediate measures to achieve urban sustainability (Zellner et al., 2008). Cities must ensure sufficient supply and distribution systems, such as water, energy, and primary services like transportation and healthcare (Wolff et al., 2017). In addition, urban residents must understand how the city operates and how their needs influence their living conditions and environment. Moreover, the growing urban population leads to increased demands on cities.

Various solutions and tools have been developed for centuries to address serious problems. Starting in the 1960s, games emerged as one such solution. While games have traditionally been associated with entertainment, they have also become serious. Furthermore, games have evolved into practical tools for addressing immediate urban needs. Urban games help people become aware of the urban environment, proving their essential role (Kocher, 2018). Therefore, urban games have become necessary for urban planning as the urban population increases, leading to high city density (Kocher, 2018).

Several studies have shown that urban games can serve various purposes. To begin with, urban (planning) games promote participation and encourage people to observe their needs in the urban environment by giving players multiple roles in the game (Reinart & Poplin, 2014). Consequently,

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urban games provide a safe environment for individuals to understand their role as members of an urban system. Games can facilitate real-world decision-making by promoting communication and collaboration among various stakeholders (Tóth, 2015). Given this focus on decision-making, it is also important to briefly address game theory. Although closely related, gaming and game theory are distinct disciplines (Shubik, 1972). According to Peters (2015), game theory, through mathematical methods, analyzes competition and collaboration situations between various participating parties. Moreover, game theory can be viewed as an analysis of social reasoning concepts (Rubinstein, 1991). From this perspective, game theory primarily focuses on analyzing the decision-making process from the viewpoint of the decision-maker(s). A gaming exercise, on the other hand, involves participants acting as themselves or in simulated roles within a real or simulated environment, often featuring elements of potential conflict or cooperation among the players (Shubik, 1972). Rather than exploring the dynamics of the decision-making process, this study focuses on the gaming experience itself and the outcomes generated by the games. Another significant purpose of games is their effective use in educational contexts, including urban planners' professional practice (Tóth, 2015). In short, one can note that games are drawing increasing attention in urban planning (Tóth, 2015).

While there is a considerable body of literature concerning urban games, a comprehensive review of the nexus between games and sustainability is needed. This paper aims to elucidate the current state of urban games in the context of sustainability and establish an initial dataset. The research questions addressed in this paper are as follows:

- What are the general categorical characteristics of existing urban games?
- What domains do these urban games prioritize within the sustainability framework?

This paper is divided into five sections, with this introduction as the first. The second section delves into the historical background of games and subsequently narrows the literature to focus on sustainability and urban games. Section three outlines the urban games gathered from existing literature and the Games 4 Sustainability website. We have categorized these games by location, number of players, target group, benefit to the target group, three sustainability pillars, and related SDGs. The fourth section presents the findings. Finally, the fifth section serves as the conclusion of the paper.

THE BACKGROUND AND DEFINITION

Games

To begin with, it is essential to clarify the meaning of "game." To define the game, we must first briefly explain "play." In the literature, these two terms are frequently used. As Huizinga (1949) described, play possesses distinct characteristics: it is voluntary, not ordinary, bound by limitations of time and space, and follows a particular order. Additionally, Caillois (2001) defines play as encompassing freedom, separateness, uncertainty, lack of productivity, adherence to rules, and an element of make-believe. Both of these definitions help clarify the broad scope of play and grasp the underlying concepts of a "game."

There is a subtle distinction between play and game. Play is generally considered less formal than a game (Zimmerman, 2004). Barron (2013) defines a game as involving several players, each with strategies leading to a quantifiable outcome that determines winners and losers. Players execute their strategies in a game, and their success determines the outcome. While defining play acknowledges specific time and space constraints and rules, games tend to have more defined rules and clear consequences. Zimmerman (2004) states: "Play, on the other hand, is uncertain, creative, improvisational, and open-ended."

Contrary to the arguments that assert a distinction between game and play, Csikszentmihalyi and Bennett do not make a clear differentiation between the two. Instead, they use terms like "play experience" or "a play form which is institutionalized" to describe the features of games. A game should involve establishing a board or a playing field and limiting choices for players by setting the rules (Csikszentmihalyi & Bennett, 1971).

As previously mentioned, the essence of the game is rooted in play. Consequently, several characteristics defined in relation to play are also applicable to games. In this context, the leading game elements are as follows (Zimmerman, 2004):

a. Voluntary

b. Interactive

c. Behavior-Constraining Rules

d. Artificiality

e. Conflict

f. Quantifiable Outcome

Having elucidated these fundamental game elements, it is imperative to explain basic game types. Therefore, we deem it necessary to examine basic game types as categorized by Csikszentmihalyi & Bennett (1971):

1. **Games of Chance:** While contemporary games of chance are often associated with monetary pursuits, historically, their origins can be traced back to religious rituals (generally played with dice).
2. **Games of Strategy:** These games require the use of abstract intellectual abilities. A prime example of such a game is chess.
3. **Games of Physical Skill:** Throughout history, games that initially relied on physical abilities to overcome

natural challenges have evolved into various disciplines, including football, baseball, basketball, and the Olympic Games.

As discussed above, a contemporary concept emerging within strategy games is that of serious games. The term "serious" denotes topics of significant interest and importance, often involving complex questions with potentially impactful outcomes (Abt, 1987). Given the intricate nature of contemporary issues, the development of serious games has become essential. Serious games have extensive applications in diverse fields such as education, planning, analysis, industrial and governmental training, and evaluation (Abt, 1987). Across these domains, the critical emphasis lies on human-centric perspectives and the discerning decisions individuals must navigate. Indeed, across numerous sectors, individuals regularly encounter complex scenarios requiring resolution. Given this human-centered focus, it is impractical to conduct experiments and examine decision-making outcomes within a laboratory environment. Hence, serious games have emerged as a pivotal tool in addressing these challenges. They provide a safe and dynamic environment for exploring significant intellectual and social issues, allowing individuals to engage in role-playing experiences that serve as valuable preparation for future societal roles (Abt, 1987).

The features of games offer valuable applications for advancing urban development and planning practices. Games can simulate specific planning processes in an engaging manner, allowing players to assume various roles and act within the game's rules, thereby promoting greater participation and interaction (Reinart & Poplin, 2014). Games can serve multiple functions within the field of planning practice. They can enhance decision-making by facilitating stakeholder communication and collecting data from citizens, while also supporting education and professional training for urban planners through various game genres and technologies (Tóth, 2015). According to Tóth (2015), the relevant game categories include:

- Raising awareness
- Encouraging citizen engagement
- Facilitating communication among stakeholders
- Collecting data from citizens
- Education

These games, utilized for various purposes within planning practice, offer numerous benefits throughout the process. The primary goal of adopting a gaming approach to planning is to simplify the process for citizens by clarifying its stages, stakeholder roles, and implicated factors, while also facilitating knowledge sharing, idea generation, and testing of innovative solutions among stakeholders (Angelidou & Psaltoglou, 2019). This is particularly relevant in urban areas, where social issues and complexities are most intensely experienced. Initially motivated by various factors, games have been extensively used in addressing urban issues, particularly those related to sustainability.

SUSTAINABILITY & SDGS

The global urban population continues to expand, with projections indicating that by 2050, 68 percent of the world's population will reside in urban areas (United Nations, 2019). Current physical and economic development practices significantly deplete natural resources, harm ecosystems, generate various pollutants, widen social inequalities, contribute to global warming, and weaken local economies and overall quality of life (Wheeler, 2013). As urbanization accelerates, so do the associated challenges. However, urban areas are not solely repositories of problems; they also serve as hubs for innovation, leveraging social capital and technological advancements to generate solutions. One proposed remedy for urban challenges is sustainable development, a longstanding solution that has been discussed for some time. In the light of this, a key challenge of the twenty-first century is building sustainable societies—a goal in which planning, by shaping development and managing connections to natural ecosystems, can play a pivotal role (Wheeler, 2013).

In the literature, a powerful explanation for "sustainability" (or "sustainable development") is the "three-pillar" concept, encompassing social, economic, and environmental dimensions (Purvis et al., 2019). If the planning approach is evaluated based on these three concepts, the theory of social sustainability asserts that that economic growth must be limited by the principles of social equity (Basiago, 1998); economic sustainability in practice involves developing urban design strategies that address public service needs—particularly for the urban poor—while enhancing the natural environment within cities (Basiago, 1998); and environmental sustainability emphasizes the need for humanity to learn how to live within the limits of the physical environment (Serageldin, 1993), advocating for a planning process that facilitates this (Basiago, 1998). This is a critical process in which planners and other key stakeholders play an essential role. Planners should leverage their professional expertise to develop sustainable planning alternatives and share the potential outcomes with politicians and the public, fostering informed discussions about these solutions within the broader context of sustainable development (Naess, 2001).

In summary, sustainability is a critical focus in planning, requiring attention to its three fundamental pillars. While remaining rooted in these core principles, discussions on sustainability today have become more detailed and advanced. In 2015, the United Nations Member States introduced a more detailed set of 17 SDGs (Figure 1) (United Nations, n.d.).

Figure 1. SDGs (United Nations, n.d.).

Additionally, novel approaches are emerging to advance sustainability efforts. For instance, urban games have become a promising avenue, serving as both educational tools and practical solutions. It is imperative to consider the significant evolving urban paradigms in conjunction with urban games. These urban planning paradigms may exhibit variations based on specific geographical locations or may be observed globally. Natural, economic, or social determinants can exert significant influence. The depletion of finite natural resources, population growth, climate change, and natural disasters directly affect urban planning.

Moreover, economic and political factors, such as global conflicts and financial crises, significantly shape planning. Finally, social factors are crucial to consider in examining urban movements, given cities' heterogeneous structure and substantial populations. Over time, social interactions transform, and cities serve as economic hubs and centers for social events. Mumford (2011) underscores this issue in What's a City?, noting that city planning is incomplete if it does not include social functions. Another essential issue is the evolving nature of interactions, which, as Castells describes, transforms through spatial change, progressing in three stages: information technology, globalization, and networking (Castells, 2002).

These natural, economic, and social factors contribute to changes in urban planning. During rapid urbanization, individuals encounter various challenges, such as disasters, climate change, war, and pandemics. While urban areas may be vulnerable to these problems, they also possess the potential to generate solutions. As mentioned, sustainable development emerges as an essential framework for mitigating these challenges. Urban areas must be equipped to address challenging conditions to pursue a sustainable development path.

The topics mentioned above shape the structure of urban games that focus on sustainability, which we will explain in the following sections.

DATA AND METHODOLOGY: A DATABASE FOR EXISTING URBAN GAMES

This section outlines the methodology employed for collecting and categorizing data on urban games. As previously stated, this paper aims to analyze and elucidate the relationship between urban games and sustainability. To achieve this, a comprehensive database was constructed to encompass existing urban games.

Data Collection

While conducting research on urban games concerning sustainability, our first step was to review the existing literature to ascertain the specific topics that serious games in the urban planning discipline address. Electronic journal databases (e.g., Scopus, Google Scholar) were searched using the keywords "gaming" and "urban planning." Among the studies found, papers featuring specific urban game examples were selected. We excluded games for which detailed information could not be located. Subsequently, nine papers were selected for further in-depth reading (Appendix A). In total, we identified 24 urban games from these nine papers.

As the number of games found in the existing literature was insufficient for evaluation, we expanded our research on urban games by accessing a website called "Games 4 Sustainability" (games4sustainability.org), which introduces and connects them to the SDGs. Games that solely prioritize entertainment value, without addressing urban issues, are excluded from this study.

Categorization

In total, we categorized 173 urban games in 2020 (Appendix B). As previously mentioned, 24 urban games were initially sourced from the literature. It is worth reiterating that these games aim to enhance participation, support decision-making processes, and contribute to planning education. During this phase, the games were categorized based on the available information, including their country of origin, whether they were individual or group-based (i.e., the number of players), their purposes (i.e., benefit to the target group), and their alignment with the three pillars of sustainability. These four criteria served as the primary means of classification at this stage.

To expand the dataset, we utilized the Games4Sustainability website, which links urban games to the SDGs, adding 149 games to the study. Since this website primarily features serious games, no major exclusions were made. However, games for which we could not gather sufficient detailed information were excluded. Additionally, categories from the website—such as target group and related SDGs—were incorporated into our analysis, resulting in six total categories. These categories provide a better understanding of the origins of the games, their relationship to sustainability, and the specific objectives they aim to achieve.

In this section, we will first present the findings, followed by a discussion of the results. Before analyzing the games based on their categorical features, we aimed to illustrate the primary themes they encompass through the word cloud below (Figure 2), reflecting their prevalence. We observe that games address various topics relevant to urban areas, emphasizing themes including disaster management, urban planning, politics and economics, climate, and water-related issues. Disaster management involves a systematic approach aimed at mitigating long-term risks to human life and property resulting from disasters (Greve, 2016).

When evaluating disasters, which are among the most critical issues affecting cities, natural disasters can be categorized into six distinct classes: geophysical (e.g., earthquakes), hydrological (e.g., floods), meteorological (e.g., storms), biological (e.g., pandemics), and extraterrestrial events (e.g., space weather) (Integrated Research on Disaster Risk, 2014). These disasters are increasingly intensified by human activities. In this context, it is essential to address the role of urbanization. Urban development has led to environmental impacts such as deforestation, land-use changes, and increased greenhouse gas emissions, all of which have heightened the potential for disasters (Nazif et al., 2021).

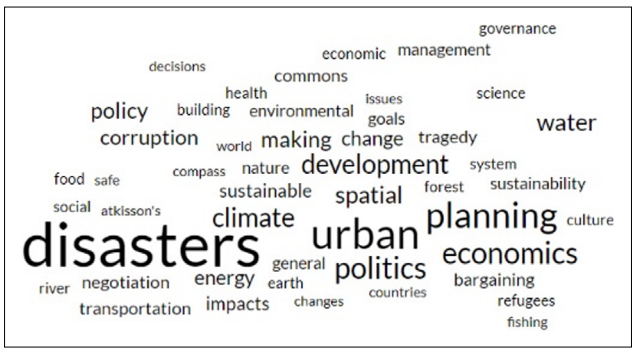

Figure 2. The Primary Themes Addressed in the Urban Games.

Another significant factor, and a critical issue on the global agenda, is climate change. Climate change can significantly impact the frequency, intensity, spatial distribution, and location of disasters (Greve, 2016). The events most affected by climate change and that trigger disasters include floods, storms, wildfires, and landslides (Greve, 2016). The impact of climate change on disasters underscores the importance of current urbanization activities and the measures that must be implemented today. Although climate change is often viewed as a future issue and can be politically overlooked, urban planners, decision-makers, and other stakeholders must recognize that climate change, disaster management, and sustainable development are interconnected policy areas that align with short-term priorities (Greve, 2016).

In conclusion, as illustrated by the word cloud, the prominence of these concepts in games serves as a key indicator for guiding and supporting the development of necessary actions moving forward. Next, we will present the analysis of the games according to their respective categories.

Location

To start, it can be noted that urban games originate from various locations worldwide. The top three countries where urban games have been launched are the United States of America, Poland and the Netherlands (Figure 3).

The Number of Players

Secondly, the games are categorised into two groups based on the number of players involved. While 42% of the games are designed for individual play, 58% are intended for group play (Figure 4).

Target Group

Thirdly, games are classified into six groups based on their target groups. The target groups include:

A (Children, Youth, Local Communities)

B (Public Administration, Policy Makers, Law Enforcement Service)

C (Business People, Financial Institutions, Insurers)

D (Non-Governmental Organizations, Aid Workers)

E (Farmers, Journalists, Educators, Sustainability Professionals)

F (Everyone)

The games exhibit 29 combinations of target groups, including A, B, A+B+D, and A+B+C+D. However, upon separate

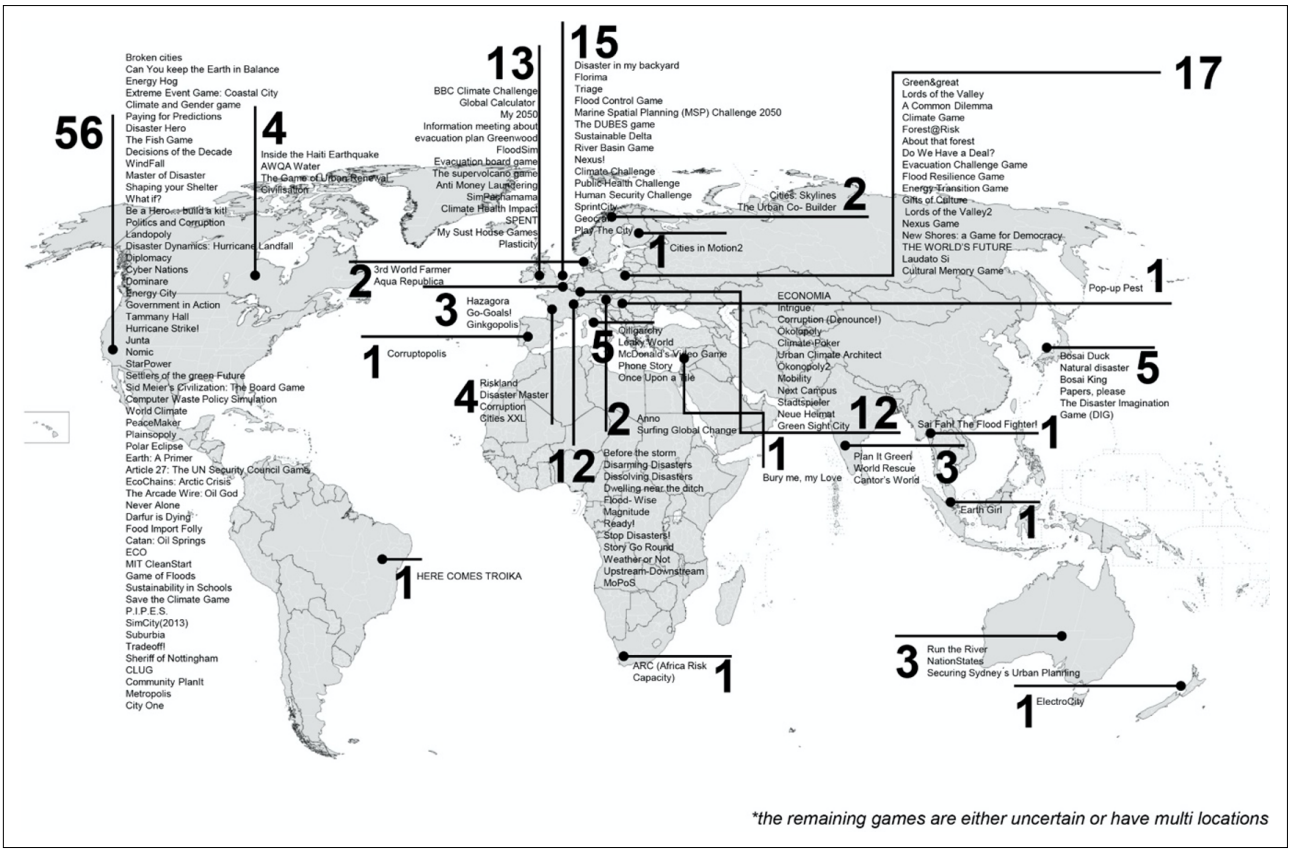

Figure 3. Urban Games Categorised by Location.

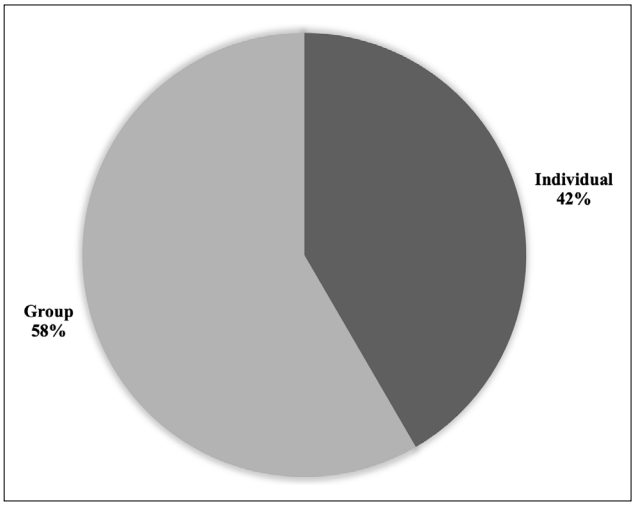

Figure 4. Urban Games Categorised by the Number of Players.

analysis, Group A's predominant involvement was observed in most games (80%). This is followed by Group B, which constitutes 52%. Further analysis of different combinations yielded several results (Figure 5). Firstly, the majority (17%) of games target only Group A, followed by games focusing solely on Group F (13%). Thirdly, the combination of Group A and F comprises 11% of the games. The fourth group (8%) includes games targeting Groups A, B, C, and D collectively. Finally, 6% of the games are designed for Groups A, B, and D. Moreover, there are 24 distinct target group combinations, each with a share of less than 5%.

Benefit to the Target Group

Across the target groups mentioned above, games aim to provide different benefits. We categorised these benefits into three groups: (1) supporting decision-making, (2) enhancing student learning, and (3) enhancing the learning of multiple stakeholders (e.g. the public, Non-Governmental Organizations, policymakers, etc.). With a majority percentage of 56%, "enhancing the learning of multiple stakeholders" constitutes the largest share. In contrast, only 9% of the games prioritise "enhancing student learning" as a benefit.

Three Pillars of Sustainability

Upon evaluating the content of the games within the framework of the three pillars of sustainability, it is evident that the games predominantly focus on the social dimension (Figure 6).

SDGs

Next, the relationships between urban games and SDGs were visualised using "Gephi", a web-based software. SDGs were uploaded into this software as central nodes, with all games subsequently added according

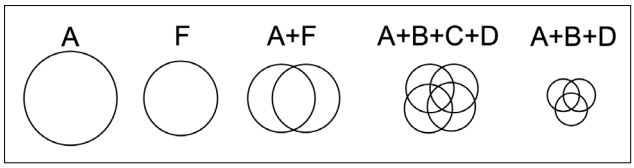

Figure 5. Urban Games Categorised by Target Group Combinations.

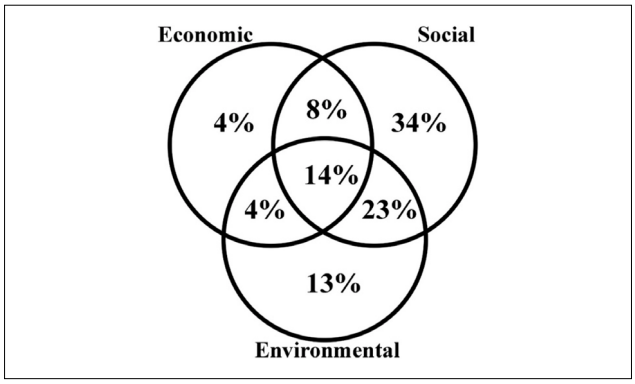

Figure 6. Urban Games Categorised by 3 Pillars of Sustainability.

to their corresponding goals. Figure 6 illustrates the interconnectedness between urban games and SDGs. As depicted in Figure 7, most games align with the "Sustainable Cities and Communities" (Goal 11). As defined by the United Nations, this goal aims to "Make cities and human settlements inclusive, safe, resilient and sustainable." Given the ongoing increase in urban population, it underscores the critical importance of urban areas. While higher population densities pose challenges for cities, they also represent opportunities for innovative solutions. Housing, transportation, and pollution are among the crucial issues that cities must address. Moreover, the recent global pandemic has profoundly impacted urban areas, highlighting the importance of Goal 11 even further.

As mentioned earlier, the primary focus in urban games tends to be on Goal 11. These games often address multiple goals, prompting an investigation into the frequency with which Goal 11 is associated with other goals. Notably, Goal 16 (Peace, justice and strong institutions) and Goal 6 (Clean water and sanitation) stand out as the goals with the most pronounced interactions with Goal 11 (Figure 8).

Finally, after evaluating the incorporation and extent of SDGs by country, it was observed that certain SDGs significantly fell below the average. These SDGs are:

- **SDG 1:** No Poverty
- **SDG 4:** Quality Education
- **SDG 5:** Gender Equality
- **SDG 14:** Life Below Water
- **SDG 17:** Partnership for the Goals

The lower prioritization of these goals can be attributed to their perception as less urgent challenges. The prioritization of SDGs usually depends on the criticality of the challenge both globally and within a specific country, often influenced by the local context and societal circumstances.

FINDINGS

We propose to partition the study findings into two primary axes. The first axis pertains to categorizing and clustering games based on their internal attributes. The second axis examines the concentration of games within the sustainability theme.

The findings related to the internal characteristics of the games were assessed according to the main subjects, player count, target groups, and the benefits they offer to these target groups. To begin with, we discuss the main subjects urban games address. Notably, games focus on disasters such as floods, earthquakes, and volcanoes. However, there appears to be a lack of games specifically addressing pandemics, which require widespread measures impacting the global population.

Secondly, we examine whether urban games are designed for individual or group play. Given societal shifts emphasizing individualism, one might anticipate a prevalence of individual games. However, contrary to this expectation, group-oriented games are more prevalent. This suggests that despite the growing emphasis on individuality, collaboration among various stakeholders remains essential for fostering robust social interactions.

Thirdly, the primary target groups for urban games include children, youth, local communities (A), and everyone (F). Urban games are positioned to encourage citizen participation. Nevertheless, the current landscape of urban games for facilitating professional urban planning and decision-making processes appears underdeveloped. Lastly, while a majority of the games aim to enhance learning outcomes, only a small fraction (9%) specifically target student learning. Despite the longstanding literature advocating for the use of games in planning education, this aspect has not received significant attention over time.

When evaluating the content of urban games through the lens of sustainability, we first apply the three-pillar framework. In this context, it can be observed that the games prioritize social issues, even when their primary themes are linked to the economic or natural environment. These games emphasize societal impacts and responses. Conversely, games focusing on economic considerations appear to be relatively fewer in number.

Secondly, when assessing games in the context of SDGs, it becomes apparent that a significant portion of them center around the goal of sustainable cities and communities,

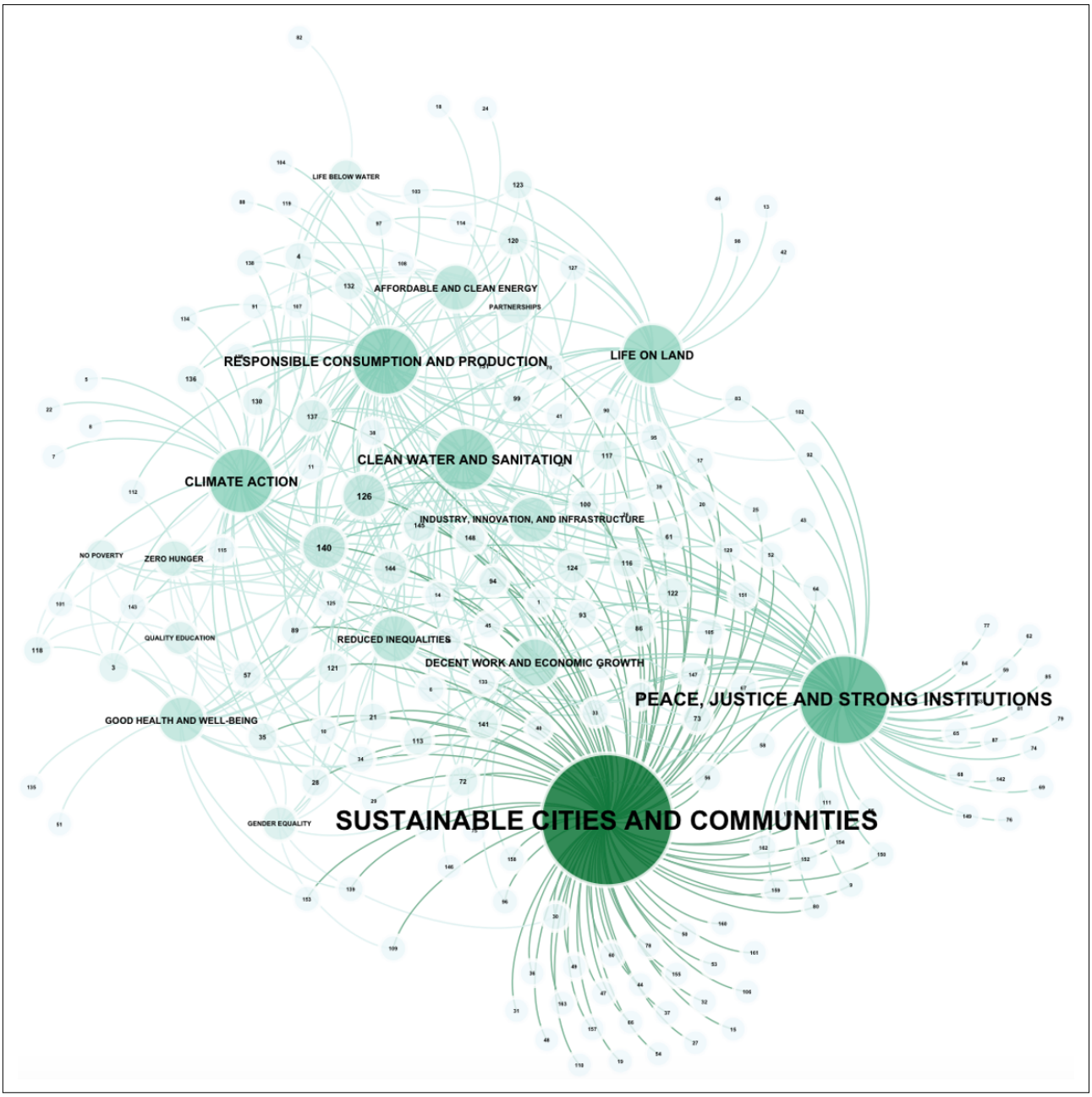

Figure 7. Urban Games Categorised by SDGs.

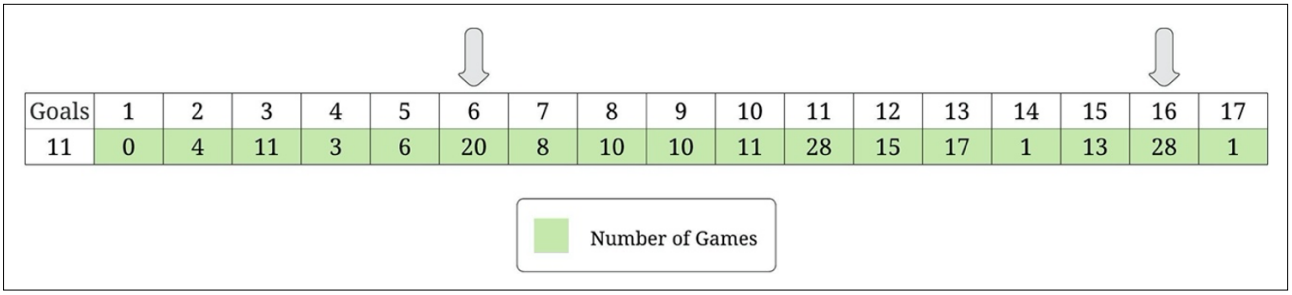

Figure 8. The Relationship of Goal 11 with the Other SDGs.

as outlined by the United Nations, which aims to "Make cities and human settlements inclusive, safe, resilient and sustainable." This emphasis underscores the pivotal role of urban areas in achieving SDGs. Scholars are urged to explore the capacity of games to foster sustainable development within urban environments. It should be noted that the number of games addressing goals such as poverty, education, gender equality, and life below water is relatively limited.

CONCLUSION

In this paper, we explored current urban games by analyzing their characteristics with a focus on sustainability. This study addressed how urban games are distributed according to their internal characteristics and relationship with sustainability. We compiled a list of 173 urban games and grouped them based on their internal attributes and relationship to sustainability. This study examines the main characteristics of the games and creates a database, providing an overview of existing games while identifying areas where they fall short. With advancements in technology, the development of these games has become more feasible. Stakeholders can either incorporate existing games into their practices or design games to meet their specific needs.

From an urban planning perspective, the following results can be drawn:

- There is an emerging trend of utilizing games in urban planning practices, particularly for engaging multiple stakeholders.
- Games primarily aim to raise awareness among individuals about sustainability-related issues. It is crucial for individuals to be aware because, in addition to measures implemented by authorities, urban residents play a significant role in maintaining sustainable cities. They must comprehend the city's functioning and the impact of their needs on their living conditions and the environment. Games serve this purpose and have significant potential for raising awareness among various actors within the city. These games can help citizens better understand and protect the resources in their cities, fostering a sense of responsibility. As individuals take on more responsibility, cities can progress more rapidly toward achieving SDGs, while experts and officials can communicate more effectively with the public.
- Existing games serve as a powerful tool for promoting public participation, a critical element in the planning process.
- The limited number of games used in decision-making processes and their focus on the general public suggest that the use of games in professional contexts is not yet widespread. Consequently, measuring and evaluating their effectiveness in this area remains challenging. Moreover, urban games should be more widely utilized to enhance coordination among various stakeholders.
- The finding that there are insufficient games designed for educational purposes in schools highlights a gap in urban planning education, suggesting the need for further development in this area.

From a sustainability perspective, two key findings emerge:

- Games prioritize social issues within the three-pillar framework, even when their themes relate to economic or natural environments.
- A significant portion of games aligns with the Sustainable Development Goal of "sustainable cities and communities," highlighting the primary role of society in accomplishing sustainability.

When the findings from these two perspectives are combined, it becomes evident that the games emphasize the role of individuals in society with regard to sustainability, highlighting their responsibilities. Ultimately, public participation stands out as a key focus.

One notable limitation of our study is the possibility of underrepresenting games due to rapid digital advancements. The growing number of games could lead to different outcomes than those presented in our current findings. For instance, if the number of games addressing the COVID-19 pandemic has recently increased, this would indicate a shift in one of our conclusions. Similarly, the growing use of games in education could also influence our results. Our dataset includes games that were accessible to us during the study period.

Future research could explore integrating urban games in planning education through case studies to enhance school learning experiences. As an initial step, it is crucial to conduct field studies on the use of games currently in our dataset, along with any newly identified games, in educational settings. These studies would assess their effectiveness and identify any shortcomings. In subsequent stages, researchers could design games tailored to specific research areas and collaborate with instructors to integrate these games into relevant courses. Since games are suitable across all educational levels, we recommend the development and inclusion of such games in urban planning education, particularly within university curricula. Furthermore, addressing urban planning challenges in the context of a pandemic could present new opportunities for developing urban games. Researchers could investigate whether new games have been developed in response to the COVID-19 pandemic and could also design games related to the pandemic, particularly those aimed at raising public awareness, similar to the games in the current dataset.

Appendices: https://tinyurl.com/y4bjazfx

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REFERENCES

Abt, C. C. (1987). Serious games. University Press of America.

Angelidou, M., & Psaltoglou, A. (2019). Social innovation, games and urban planning: An analysis of current approaches. Int J Electron Gov, 11(1), 5–22.

Barron, E. N. (2013). Game theory: An introduction (Vol. 2). John Wiley & Sons.

Basiago, A. D. (1998). Economic, social, and environmental sustainability in development theory and urban planning practice. Environmentalist, 19(2), 145–61.

Caillois, R. (2001). Man, play, and games. University of Illinois Press.

Castells, M. (2002). Local and global: Cities in the network society. Tijdschr Econ Soc Geogr, 93(5), 548–58.

Csikszentmihalyi, M., & Bennett, S. (1971). An exploratory model of play. Am Anthropol, 73(1), 45–58.

Duffhues, J., Mayer, I. S., Nefs, M., & Van Der Vliet, M. (2014). Breaking barriers to transit-oriented development: Insights from the serious game SPRINTCITY. Environ Plann B Plann Des, 41(5), 770–791.

Greve, A. I. (2016). Sustainable development, climate change adaptation and disaster management. In J. I. Uitto & R. Shaw (Eds.), Sustainable development and disaster risk reduction (pp. 13–36). Springer Japan.

Huizinga, J. (1949). Homo ludens: A study of the play-element in our culture. Routledge & Kegan Paul.

Imottesjo, H., & Kain, J. H. (2018). The urban CoBuilder – A mobile augmented reality tool for crowd-sourced simulation of emergent urban development patterns: Requirements, prototyping and assessment. Comput Environ Urban Syst, 71, 120–130.

Integrated Research on Disaster Risk. (2014). Peril Classification and Hazard Glossary (IRDR DATA Publication No. 1). Integrated Research on Disaster Risk.

Juhola, S., Driscoll, P., de Suarez, J. M., & Suarez, P. (2013). Social strategy games in communicating trade-offs between mitigation and adaptation in cities. Urban Clim, 4, 102–116.

Juraschek, M., Herrmann, C., & Thiede, S. (2017). Utilizing gaming technology for simulation of urban production. Procedia CIRP, 61, 469–474.

Kocher, M. (2018). Game mechanics of serious urban games: Designing for the Ludic City. In B. Suter, M. Kocher, & R. Bauer (Eds.), Games and rules: Game mechanics for the magic circle (pp. 267–89). Verlag.

Mayer, I., Meijer, S., Nefs, M., Gerretsen, P., & Dooghe, D. (2010). Gaming the interrelation between rail infrastructure and station area development: Part 2-insights from the serious game 'SprintCity'. In Next Generation Infrastructure Systems for Eco-Cities (pp. 1-6). IEEE.

Mumford, L. (2011). What is a city: Architectural record (1937). In R. T. LeGates & F. Stout (Eds.), The city reader (pp. 123–27). Routledge.

Naess, P. (2001). Urban planning and sustainable development. Eur Plan Stud, 9(4), 503–24.

Nazif, S., Mohammadpour Khoie, M. M., & Eslamian, S. (2021). Urban disaster management and resilience. In S. Eslamian & F. Eslamian (Eds.), Handbook of disaster risk reduction for resilience (pp. 157–85). Springer Nature Switzerland.

Peters, H. (2015). Game theory: A multi-leveled approach. Springer.

Purvis, B., Mao, Y., & Robinson, D. (2019). Three pillars of sustainability: In search of conceptual origins. Sustain Sci, 14(3), 681–95.

Reinart, B., & Poplin, A. (2014). Games in urban planning – A comparative study. In M. Schrenk, V. V. Popovich, P. Zeile, & P. Elise (Eds.), REAL CORP 2014–PLAN IT SMART! Clever Solutions for Smart Cities Proceedings of 19th International Conference on Urban Planning, Regional Development and Information Society (pp. 239–48). CORP.

Rubinstein, B. Y. A. (1991). Comments on the interpretation of game theory. Econometrica, 50(1), 97–109.

Scholten, H., Fruijtier, S., Dias, E., Hettinga, S., Opmeer, M., van Leeuwen, W. S., Linde, M., Bos, S., Vaughan, R., van Kaam, H., van Manen, N., & Fruijtier, C. (2017). Geocraft as a means to support the development of smart cities, getting the people of the place involved-youth included. Qual Innov Prosper, 21(1), 119–150.

Serageldin, I. (1993). Making development sustainable. Finance Dev, 30(4), 6–10.

Shubik, M. (1972). On gaming and game theory. Manage Sci, 18(5-part-2), 37–53.

Tan, E. (2016). The evolution of city gaming. In Complexity, Cognition, Urban Planning and Design: Post-Proceedings of the 2nd Delft International Conference (pp. 271-292). Springer International Publishing.

Tóth, E. (2015). Potential of games in the field of urban planning. In T. Bártek, J. Miškov, & J. Švelch (Eds.), New Perspectives in Game Studies: Proceedings of

the Central and Eastern European Game Studies Conference Brno 2014 (pp. 71–91). Masaryk University.

United Nations. (2019). World Urbanization Prospects: The 2018 Revision (ST/ESA/SER.A/420). United Nations.

United Nations. (n.d.). 17 Goals. https://sdgs.un.org/goals

Wheeler, S. (2013). Planning for sustainability: Creating livable, equitable and ecological communities. Routledge.

Wolff, A., Valdez, A. M., Barker, M., Potter, S., Gooch, D., Giles, E., & Miles, J. (2017). Engaging with the smart city through urban data games. In S. Nijholt (Ed.), Playable cities (pp. 47–66). Springer.

Zellner, M. L., Theis, T. L., Karunanithi, A. T., Garmestani, A. S., & Cabezas, H. (2008). A new framework for urban sustainability assessments: Linking complexity, information and policy. Comput Environ Urban Syst, 32(6), 474–88.

Zimmerman, E. (2004). Interactivity, play, and games: Four naughty concepts in need of discipline. In N. Wardrip-Fruin & N. Montfort (Eds.), First Person: New Media as Story, Performance, and Game (pp. 56–57). The MIT Press.